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PUBLICATIONS.

Report on the Geology of the Coastal Plain of Alabama, Geological Survey of Alabama (pp. xxiv–759). By EUGENE ALLEN SMITH, State Geologist, Montgomery, Ala., 1894.

This report, which treats of all the post-Palæozoic formations of Alabama, is one of value. It deals with matters which are of importance in themselves, and it deals with them in an intelligent way. The matter is so presented that those who are interested in the conclusions only, can find them without laboring through the details, while those whose interests lie in such directions as to make details valuable, will not be disappointed. It is interesting to note that Dr. Smith has conformed to the recent practice of some other state geologists in prefacing his report by an introductory chapter which is intended to make the body of the report intelligible to readers who are not geologists. This practice is to be especially commended in state survey reports. Had it been in vogue since the beginning of state survey publications, geological reports would have been much more widely read, and read with much more understanding and interest by the citizens of the states for whom they are or should be intended. It would appear that the coastal plain formations of Alabama have been worked out with so much detail that in the future Alabama is likely to be the starting point for the correlation of many of the coastal plain formations in the gulf region. The formations and their relations are shown in the following table:

POST-TERTIARY OR QUATERNARY.

Recent.

1. Coast sands and alluvium, upper part of the Biloxi — 10 to 100 ft.
2. First bottoms and other alluvial deposits of the streams.
3. Soils and rainwash.

Pleistocene.

1. Coast deposits, lower part of the Biloxi, coastal — 150 to 200 ft.
2. Mobile Bay formation. (Mon Louis Island), estuarine, undetermined.
3. Second bottom terraces of the rivers, undetermined but over 60 ft.
4. Ozark or Conecuh sands. Sand terraces — undetermined.

1. Third Terraces of the rivers (surface deposits)	10 to 20 ft.
2. The Lafayette mantle (Orange Sand, Appomattox)	25 to 200 ft.

TERTIARY.

Miocene.

1. Pascagoula	Thickness undetermined, about 200 ft.
2. Grand Gulf	" " at least 500 ft.

Eocene.

1. St. Stephens, White Limestone (Vicksburg and Jackson)		200 to 350 feet.
2. Claiborne		450 "
a. Claiborne proper	150	
b. Buhrstone	300	
3. Lignitic		825 to 850 "
a. Hatchetigbee	175	
b. Bashi or Wood's Bluff	80–85	
c. Tuscahoma or Bell's Landing	140	
d. Nanafalia	200	
e. Naheola or Matthew's Landing	130–150	
f. Sucarnochee or Black Bluff	100	
4. Clayton. (Midway)		25 to 200 feet.

CRETACEOUS.

	West Ala.	East Ala.
1. Ripley	250–275	1000
2. Rotten Limestone or Selma Chalk	1000	000
3. Eutaw	300	300
4. Tuscaloosa	1000	500

The tracing out of the several formations has made it possible to determine with some accuracy, not only the periods and phases of oscillatory movement of the southern part of the state, but also the deformations which accompanied these movements. Hardly anywhere else along the coastal plain region have we such explicit data concerning Cretaceous and post-Cretaceous movements.

As will appear from the preceding table, a distinction is made between the Recent and the Pleistocene formations, but no sharp line of division is drawn. The coastal portion of the Recent series is found to be continuous below with what is classed as Pleistocene, the two together constituting the Biloxi formation. The division between the Recent and the Pleistocene is therefore in the midst of a conformable series.

The second bottom terraces of the rivers is a fluviatile Pleistocene formation, which at Mobile Bay grades into a deposit of estuarine origin — the Mobile Bay formation. Traced seaward this formation becomes continuous with the Biloxi, or at least with its lower part. The first, second, and third formations assigned to the Pleistocene in the above table, are therefore the fluviatile, estuarine and marine subdivisions of the same formation.

Five to ten feet above the second bottom terraces, there is another series of sand terraces (No. 4 of above table) along the main streams. From their position these terraces appear to be somewhat older than the second bottom terraces. Along the minor streams, the sand terraces appear to be the main terraces. Sand similar to that of which these terraces are composed covers some of the inter-stream areas and divides, up to altitudes of 100 feet. This is the Ozark or Conecuh sand. This inter-stream sand is compared to the inter-stream phase of the Columbia, as developed at other points on the coastal plain, especially farther north. While therefore the first three of the Pleistocene formations, as shown in the table, are essentially equivalent, the fourth seems to be somewhat older.

Along the principal streams there are "third terraces" which are 50 to 100 feet above the second bottoms. These third terraces consist of red loam with more or less gravel beneath it. Their constitution is in all respects comparable to the constitution of the Lafayette formation, as developed at higher levels. These third terraces sustain the same relation to the Lafayette formation which covers the inter-stream areas, that the sand terraces (No. 4) do to the Ozark or Conecuh sand, though the third terraces and the Lafayette lie at higher levels than the sand terraces and the Ozark and Conecuh sands. The third terraces are very much wider than the second bottom terraces, and are, as all their relations show, considerably older.

The Lafayette formation finds its normal development above the third terraces. Dr. Smith's suggestions concerning the origin of this formation are of interest, and his classification of the same should be especially noted, in view of the fact that he has recently been quoted[1] as holding that the Lafayette is Pleistocene. His words are as follows:

> "The general appearance of the formation, and the demonstrably great amount of erosion which it had suffered before the deposition of the undoubted Pleistocene beds, would lead us to conclude that a long period of time and important physical changes occurred between the accumulation of the Lafayette and the Pleistocene deposits. For these reasons, the weight of evidence

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[1] UPHAM. Am. Nat. Vol. XXVIII., p. 979, 1894.

appears to be in favor of classifying the Lafayette as the upper member of the Tertiary (Pliocene) formation, and so I have represented it on the geological map of the state" (p. 81–82).

This would seem to be sufficiently explicit, were not some doubt thrown on this correlation in other connections. Thus we find the following :

"The great amount of erosion which took place after the deposition of the Lafayette, and before that of the next overlying deposits, has been urged as an objection to the placing of the Lafayette in the same category with the Pleistocene, but the same objection might, with equal force, be urged against classifying it with the Tertiary, since an equally great, if not greater, amount of erosion occurred between the deposition of the Miocene beds and those of the Lafayette" (p. 82).

This last statement is certainly a little curious. If the alternative were between classifying the Lafayette as Pleistocene or as Miocene, the point here made would have force. But this is not the alternative, and Dr. Smith does not really so regard it, for he classifies the Lafayette, not as Miocene or as Pleistocene, but as Pliocene. If the argument of the last citation had been urged as a reason for separating the Lafayette from both the Pleistocene and the Miocene, making it Pliocene, as Dr. Smith has really done, it would seem weighty. To use this argument for the purpose of raising the question as to whether the Lafayette is not really Pleistocene, is to take the position that an unconformity may be admitted in the Pleistocene, but not in the Tertiary. It is to take the position that different members of the Pleistocene may be much more sharply separated from each other than Pliocene from Miocene. This is a position which we believe to be untenable. The above citation does not seem to the writer to have weight against the classification of the Lafayette as Pliocene, for it is not clear that there may not have been an erosion interval between the Miocene and the Pliocene. It is true that unconformities are known in the extra-glacial Pleistocene, but they are much less considerable than the unconformity above the Lafayette. Of much more significance, in the judgment of the writer, is the constitution and physical condition of the Lafayette. Dr. Smith says: "As yet the existence of material of glacial origin among the Lafayette beds, seems not to have been proven beyond question" (p. 81). This does not seem to quite express the true condition of things. The Lafayette beds have been widely studied by many observers. Not only has glacial material not been proven to exist in them, but in the most northern areas of the Lafayette, as shown by numerous exposures, glacial material has been shown to be absent. This is no more than negative evidence against the Pleistocene age of the Lafayette; but the volume of negative evidence is so great that it has carried conviction to every geologist, so far as we know, who has studied critically both the glacial drift and the Lafayette formation.

Concerning the origin of the Lafayette, Dr. Smith appears to incline to the view which has been advocated by McGee, viz., that the Lafayette materials were deposited during submergence of the region which they cover. In this connection a new suggestion is made concerning the relation of the third terraces noted above, to the body of the Lafayette. The suggestion is that in the emergence of the land on which the Lafayette had been deposited, the rivers flowing down over it brought in new material from the north, in this way, perhaps, adding a land accumulation to the marine accumulation which had already been made. It is suggested further, that in the course of time these streams came to be confined in more or less well-defined valleys of their own development, and that at some stage during the uplift, there was a halt of such duration that the broad valleys which these streams occupied were filled up by the streams to the level of the third terraces. This would make the third terraces "the last episode of the Lafayette drama." As the valleys were filled, the coarse materials lodged first, and the fine later, thus giving the relations which are found to exist. Dr. Smith points out very distinctly that these third terraces of Lafayette-like material do not grade into the second terraces, as has sometimes been supposed.

A good deal that is new appears in connection with the Miocene. Two distinct divisions of the Miocene are recognized. The uppermost is the Pascagoula, which has a thickness of something like two hundred feet. It is composed mainly of clays, with more or less green sand. Below this lies the Grand Gulf formation, the age of which has been definitely fixed as lower Miocene.

The data of this report concerning the Eocene have been largely published before in Bulletin 43 of the United States Geological Survey. The present report proposes some modifications in the classification there given, and publishes some new facts, the result of recent field work.

The average seaward dip of the Tertiary formations is said to be twenty-five to thirty feet per mile. Even these young and, on the whole, regularly disposed formations are not free from considerable deformations. A fault has been found in the western part of the state, having a vertical throw of at least 200 feet. Two distinct and broad, though rather low, anticlines have been found in the same region. Both of them have a northwest southeast course. Neither of them appears to have affected the drainage of the region where they occur.

The subdivisions of the Cretaceous are given above. It is worthy of note that the four subdivisions of the formation which occur in the western part of the state cannot all be carried across to the eastern border, the two uppermost members, the Ripley and the Rotten Limestone, losing their distinctness. The name *Selma Chalk* is proposed as a substitute for the old name "Rotten Limestone," and it is to be hoped that the change may be generally adopted.

In connection with the Cretaceous, it is pointed out that the Tuscaloosa is probably the equivalent of the Amboy (Raritan) clays of New Jersey, and that this formation seems to hold its character from Massachusetts to Alabama. Judged from the physical standpoint, the other members of the Cretaceous of Alabama cannot be said to have much in common with their northern equivalents.

Many details are given concerning the palæontology of the formations described. The microscopic fossils, as well as the larger ones, have received a considerable measure of attention.

Through the whole series of the Cretaceous, Tertiary and Pleistocene formations of Alabama, the influence of the Mississippi River has been felt, a large part of the coastal plain region of Alabama coming within the great Mississippi embayment of these periods. The rivers which cross the coastal plain are all of recent origin.

The later part of the volume is occupied by county descriptions which possess a local interest, and give many sections which will be of value to students of coastal plain geology, since they will offer a basis for classification and correlation.

The economic resources of the coastal plain region are not neglected. This part of the state is far less rich in economic products than the northern part, where the great iron and coal industries flourish. Nevertheless the phosphates and clays of the central and southern parts of the state are of value, and when more extensively used the former seem destined to have an important bearing on the agricultural welfare of the state.

The phosphates are found at several horizons, but the most important are at or near the base, and at the top of the Selma Chalk. The phosphate-bearing member at the base of the series is known as the "Eutaw, Hamburg, Selma Belt" because it is well developed at those places. For a similar reason the phosphate-bearing member at the top of the series is known as the "Livingston, Fort Deposit, Union Springs Belt." In limited quantities phosphates have also been found in other parts of the same formation. Each of the principal phosphate horizons consists, not of one stratum, but of several different strata containing phosphates in various forms. They are extensively developed throughout the Cretaceous area, from the northwest part of the state to the Georgia border.

The phosphates at the base of the Selma Chalk occur as nodules and phosphatic casts of fossils, as phosphatic sands and glauconites, or as calcareous marls containing more or less phosphate. The nodules are associated with numerous worn and rounded casts of Cretaceous fossils, such as ammonites, baculites, nautili, etc., which are also often highly phosphatic, as well as with many sharks' teeth and bones of saurians. These nodules and fossils are enclosed in a soft, calcareous matrix, and sometimes in glauconite. The nodules and some of the fossil casts are the richest phosphates found, and often contain from 40 per cent. to over 80 per cent. phosphate of lime. The phosphatic sands, glauconites and marls are much lower grade, containing from 1 to 20 per cent. of phosphate of lime, and often averaging not over 1 to 3 per cent., but they are in much larger quantities than the nodules. The phosphates of the "Livingston, Fort Deposit, Union Springs Belt," are similar to those of the lower horizon.

The Tertiary strata, as well as the Cretaceous, sometimes contain phosphates, but they are less abundant, and are of lower grade. They occur mostly in the Lignitic, White Limestone and Claiborne members of this series, and are in the form of scattered nodules and phosphatic marls.

It is shown that the phosphate deposits occur along lines of non-conformity, and that the fossil casts, etc., are all more or less worn. Professor Smith supposes the presence of the phosphates to be due to the phosphatization of fossil casts, marls, limestones, etc., during the formation of these non-conformities, and the source of the phosphates he ascribes to the decay of animals and plants, and of phosphate-bearing rocks. He shows that though the phosphate localities rarely possess sufficient quantities of high-grade material to be profitably shipped, yet the phosphates and phosphatic marls are of great use to the farmer in the vicinity. The purely calcareous marls are discussed, and their value shown. The clays for pottery, brick and tile making are also briefly treated, and some of them are shown to be of good quality.

Dr. Smith's work has been carried on unostentatiously for many years. The present volume is not the first piece of good work which he has done. The large results which he has brought out are altogether incommensurate with the meager appropriations which have been at his disposal. While the co-operation of the United States Survey has been of much service to his work, a service which he fully acknowledges, much credit still belongs to the state geologist himself.

ROLLIN D. SALISBURY.

Dr. K. v. Chrustschoff, Ueber Holokrystalline Makrovariolitische Gesteine. Memoires de L'Academie Imperiale des Sciences de St. Petersbourg, VII. Série, Tome XLII., No. 3. St. Petersbourg, 1894. 4to, 244 pp., 3 plates and 37 figures.

The author in his introduction refers to the work already done on the subject, and shows how in the case of the true variolite ("an endomorphic contact phenomenon of diabase") the consideration of the origin is simple in comparison with the genetic history of the orbicular structure in holocrystalline, eugranitic, plutonic rocks. The origin of these are entirely different.

Finding the references to these holocrystalline orbicular rocks to be unavailable he collected them and presents a bibliography of the special studies on spheroidal building, orbicular granites, diorites, gabbros, and diabases.

As the most direct means of approaching the subject Chrustschoff chooses six of the more noted occurrences of variolitic rocks, along with four new occurrences (two in Sweden, one in Silesia, and one in Siberia), making ten, which serve as the subject of discussion for the volume. With each example the author carefully analyses the varioles into an inner core (kern) and various concentric rims (calotte) which may or may not possess radial arrangements in conjunction with their neighbors. The mass of the rock and each of these divisions is in turn studied carefully, and the optical characteristics, order of sequence in crystallization, and very frequently the chemical composition of the various constituents are discussed in detail.